

# Bugs, Bioassessment and Biocriteria

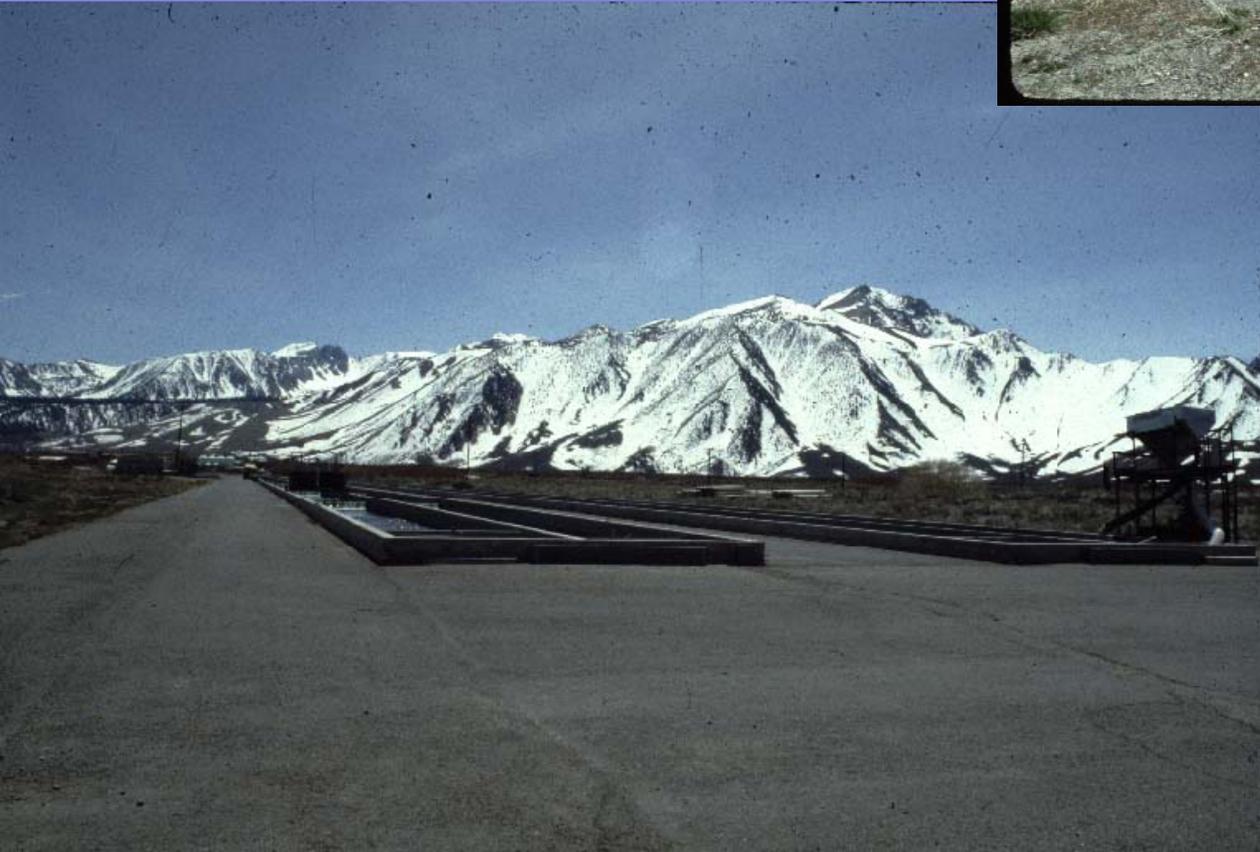


**AFS/SRF Conference  
Redding, Ca  
March 10-13, 2010**

**Jim Harrington  
WPCL Bioassessment Laboratory**

California Department  
Of Fish and Game

Hot Creek Hatchery  
NPDES Permit



**1993 in permit**

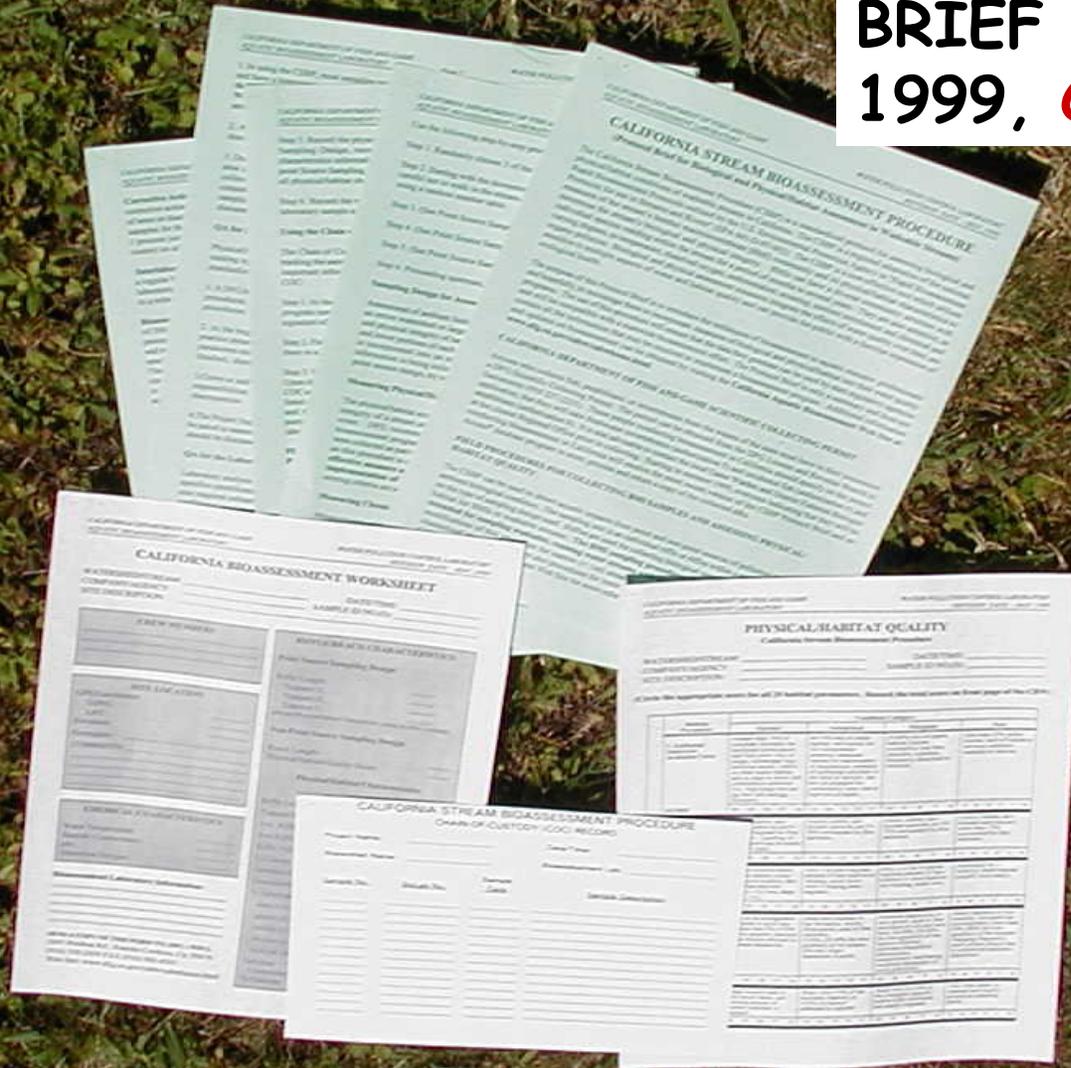
**No response**

**1999-2004**

**2005 SI process**

**Continue monitoring**

# CSBP PROTOCOL BRIEF - 1993, 1996, 1999, **CSBP 2004**

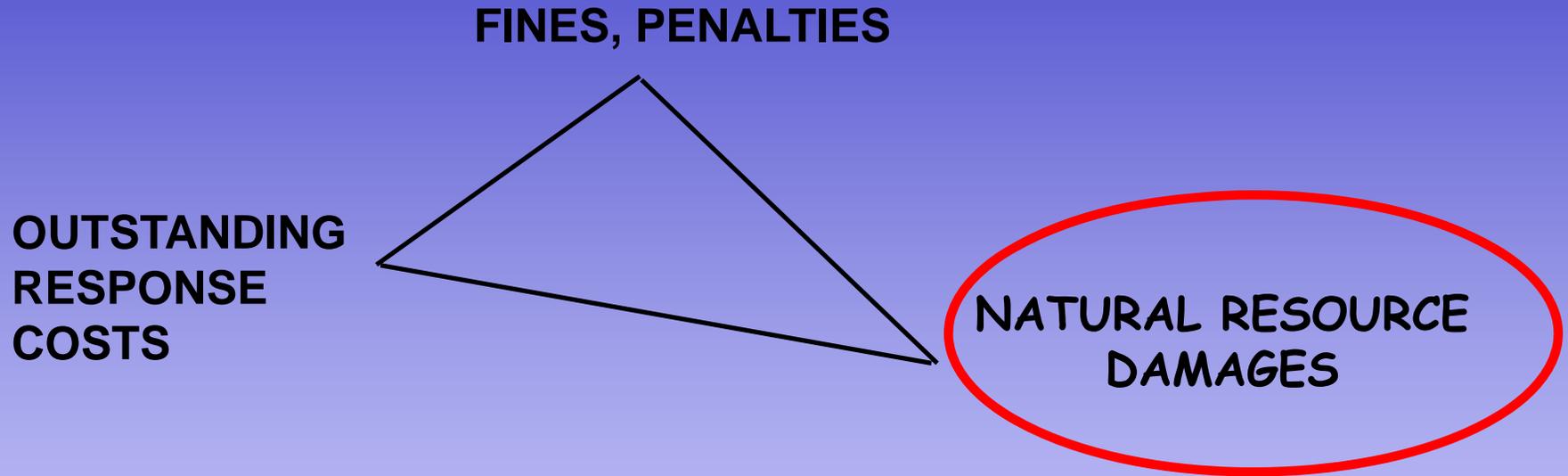


# Enforcement of DFG Code 5650

## Spill Response



# Potential Components of an Spill Settlement

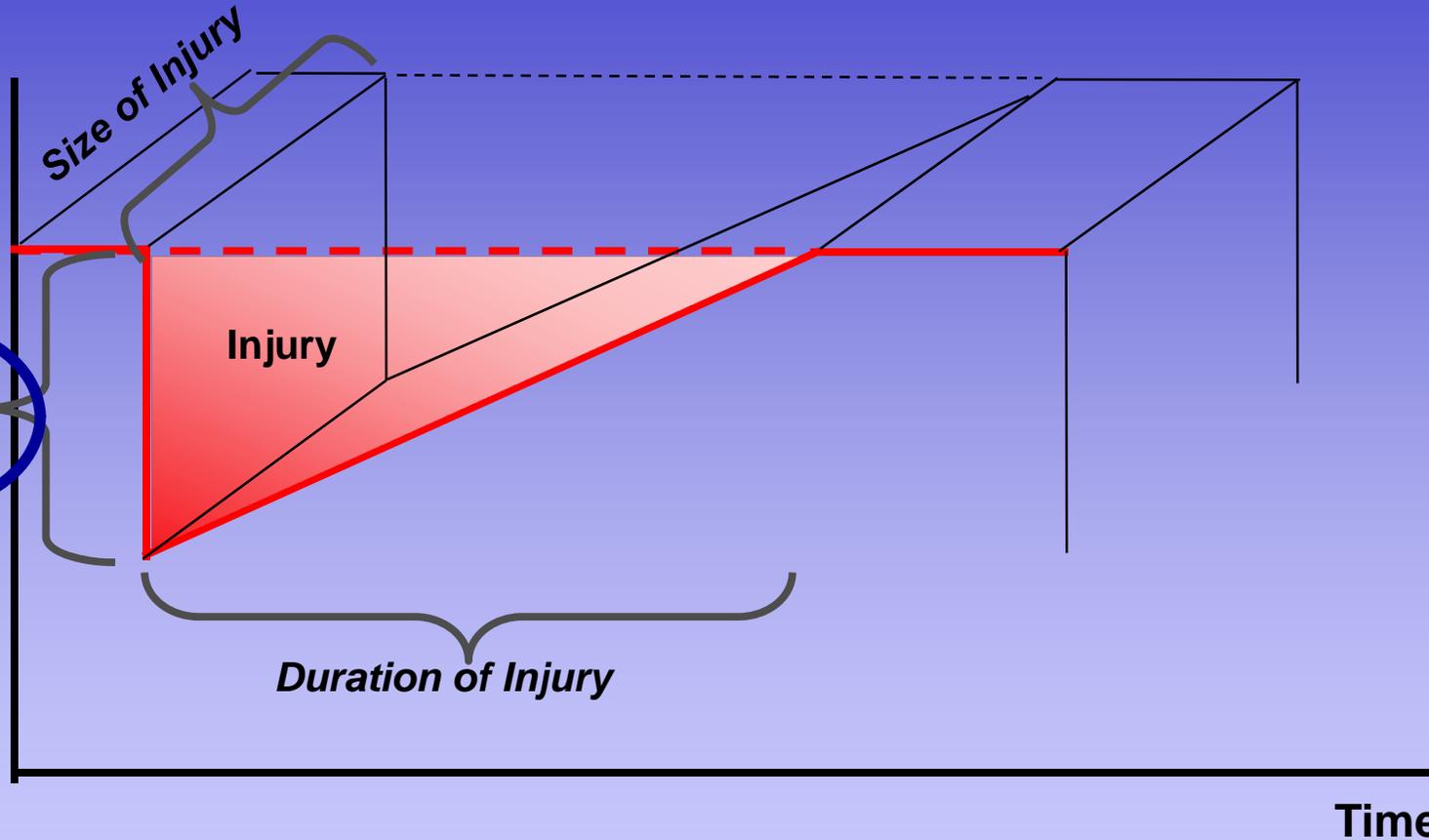


# Habitat/Resource Equivalency Analysis

Level of  
Resource  
Services

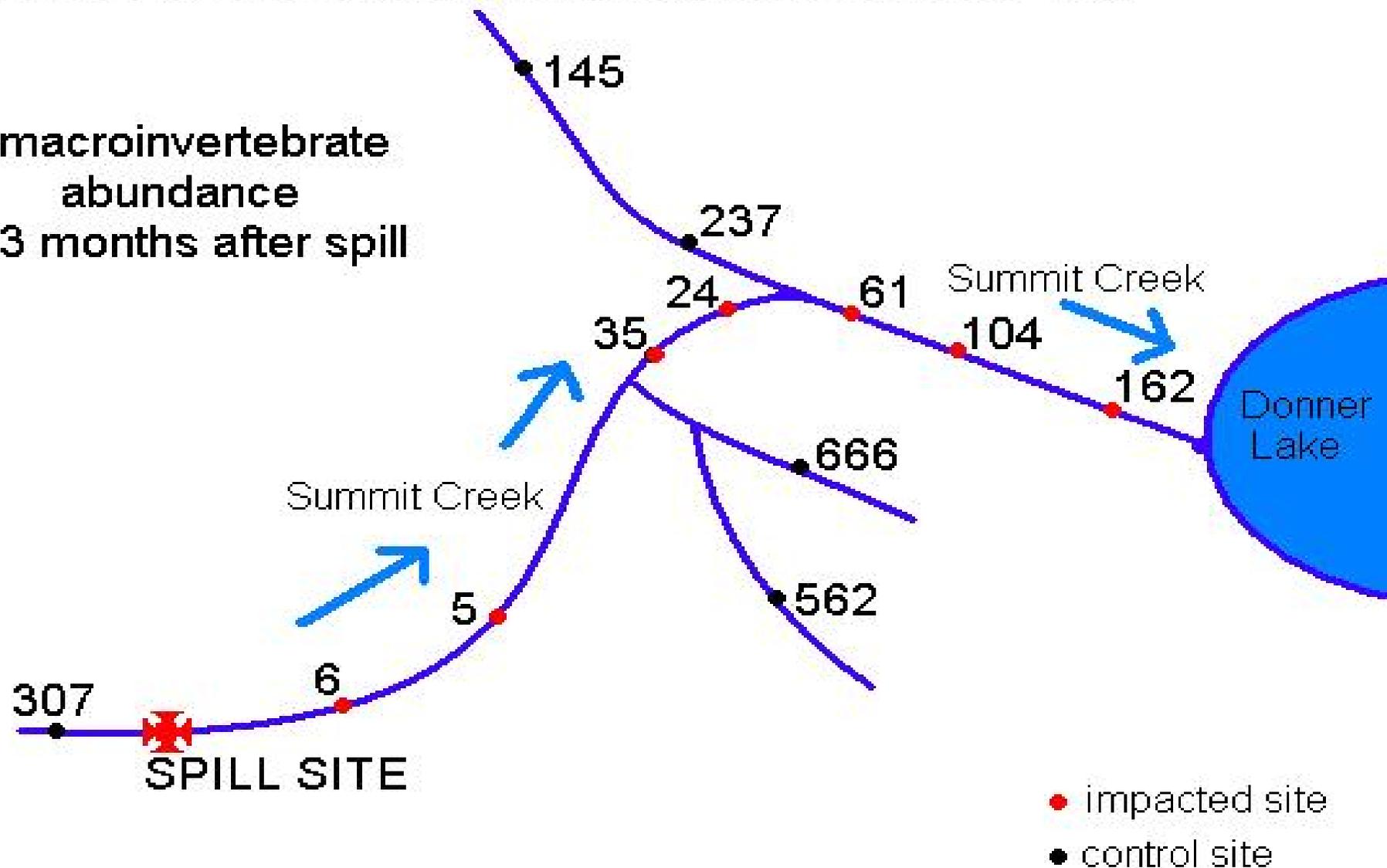
Initial  
Level

*Degree  
of Injury*



# Sante Fe Pipeline/Summit Creek Pipeline Leak, 1997

macroinvertebrate  
abundance  
3 months after spill

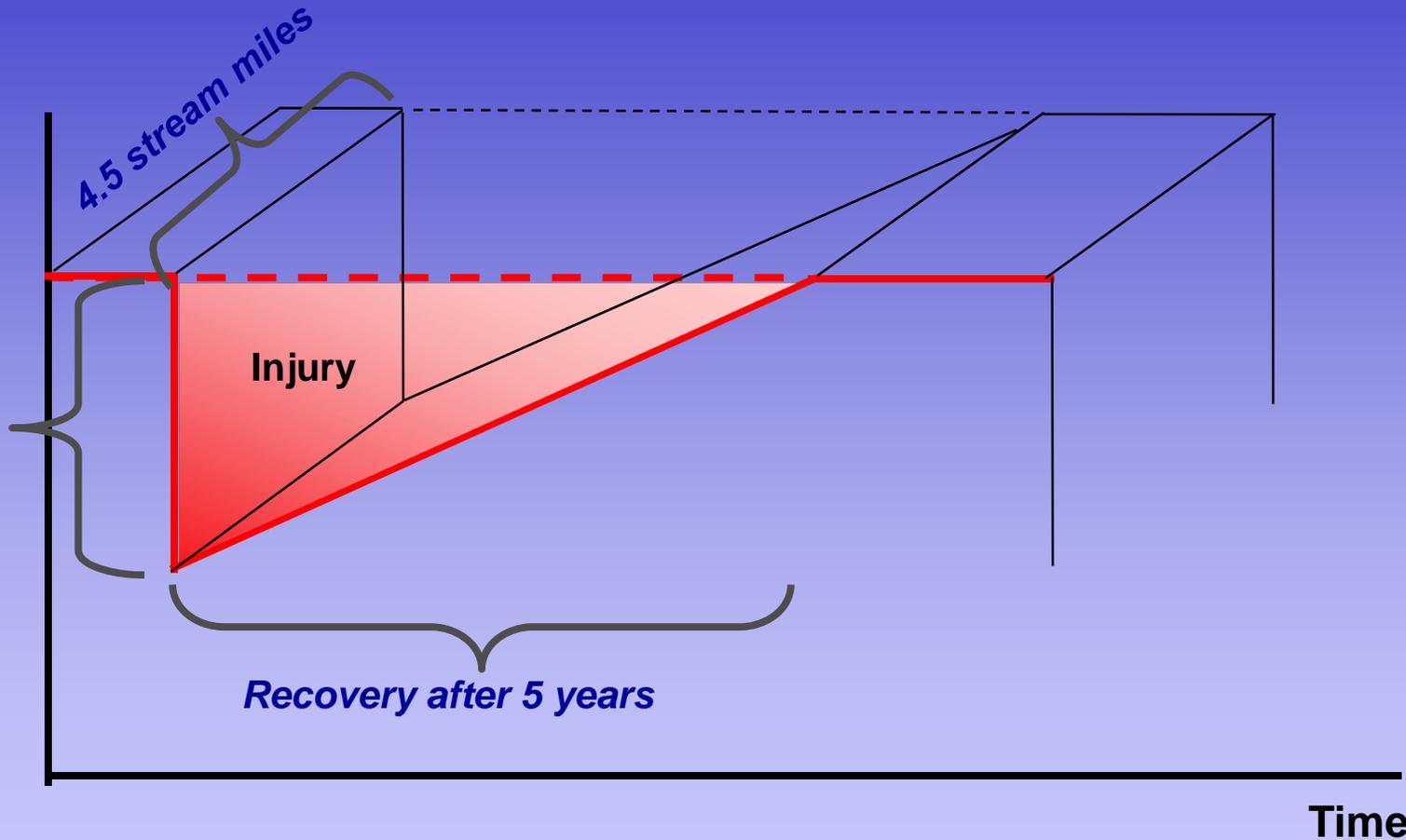


# Habitat/Resource Equivalency Analysis

Level of  
Resource  
Services

Initial  
Level

98%  
Injury



Product of the Model X DFG Restoration Costs



Starting  
2000



# Western Pilot EMAP and CMAP



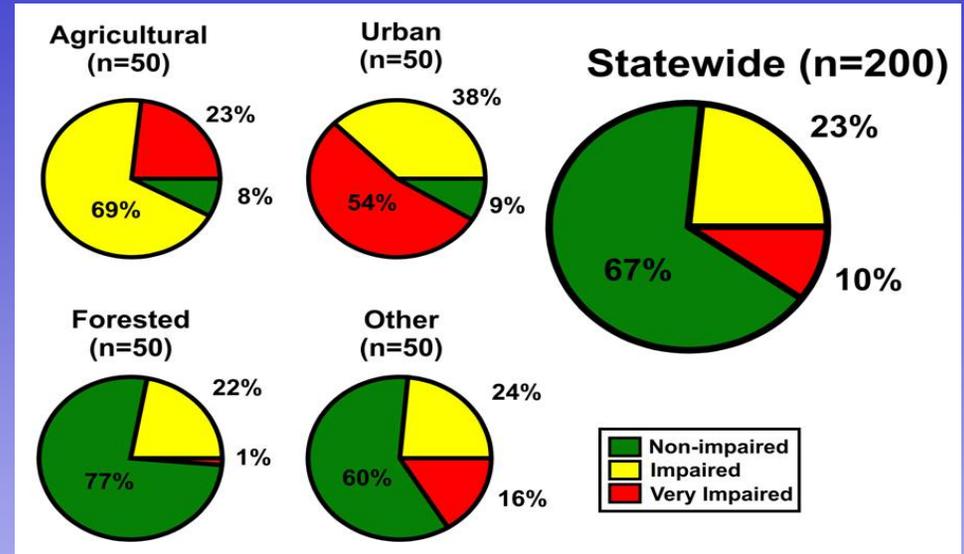
CDFG  
U.S. EPA  
SWRCB  
RWQCB



# Key Products of PSA

## Condition Assessments

(% of stream length in different condition classes)

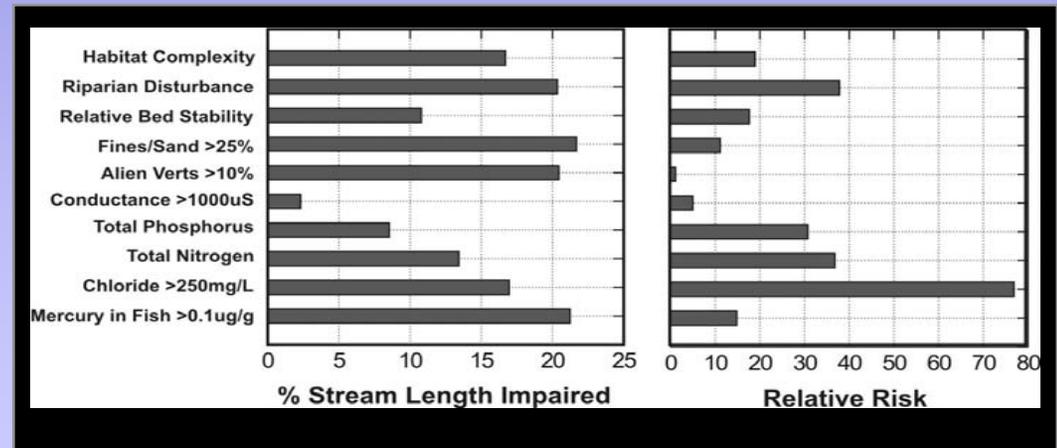


## Stressor Extent

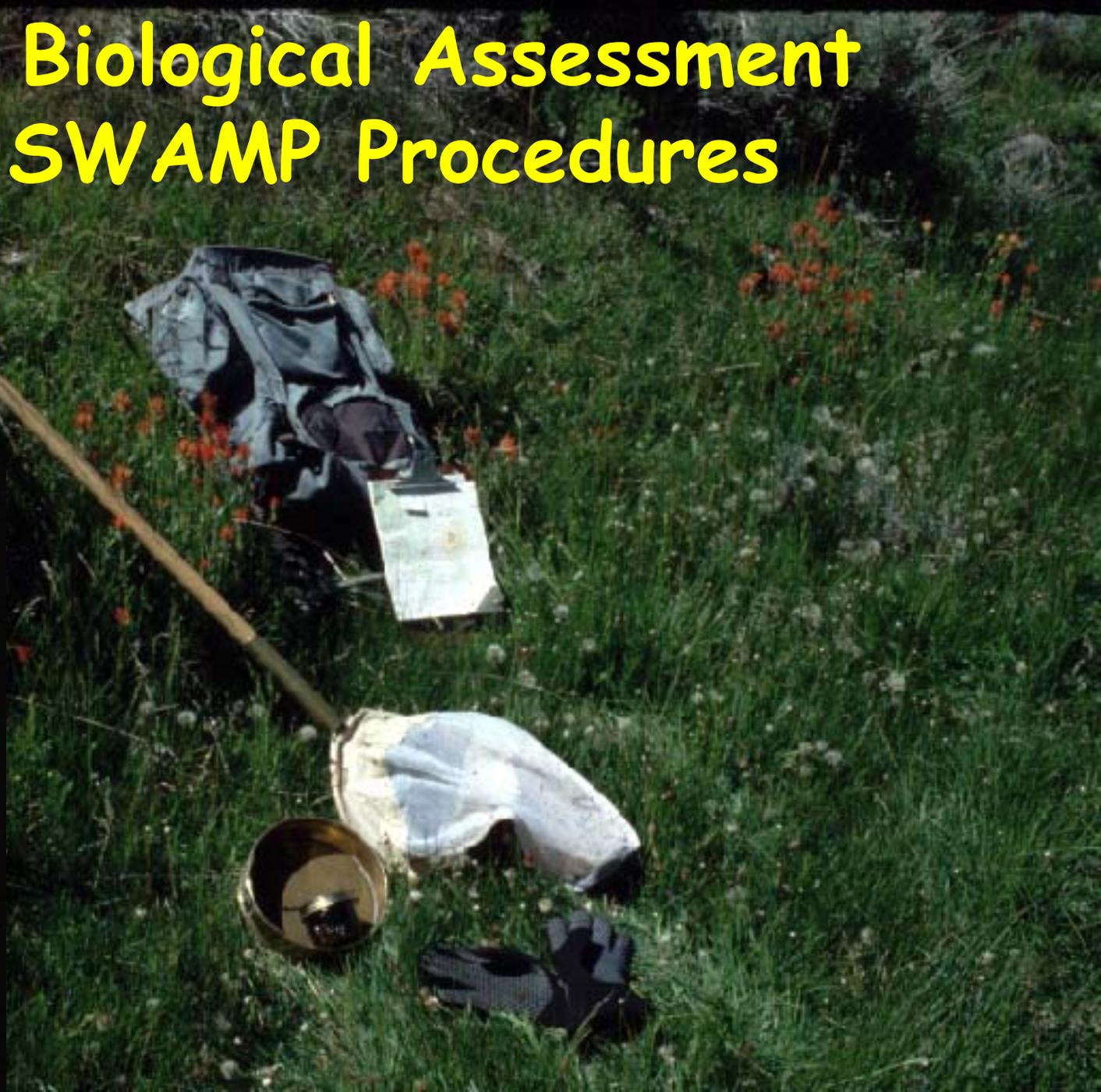
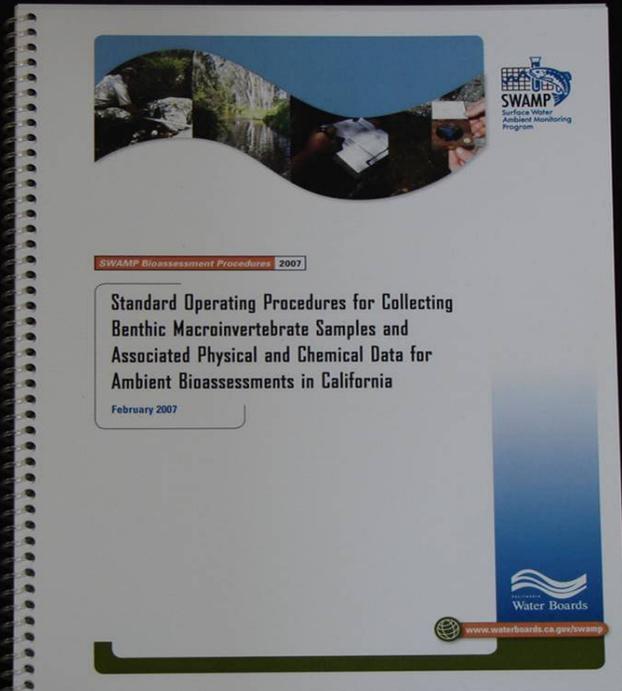
(% of stream length associated with high levels of various stressors)

## Relative Risk Estimates

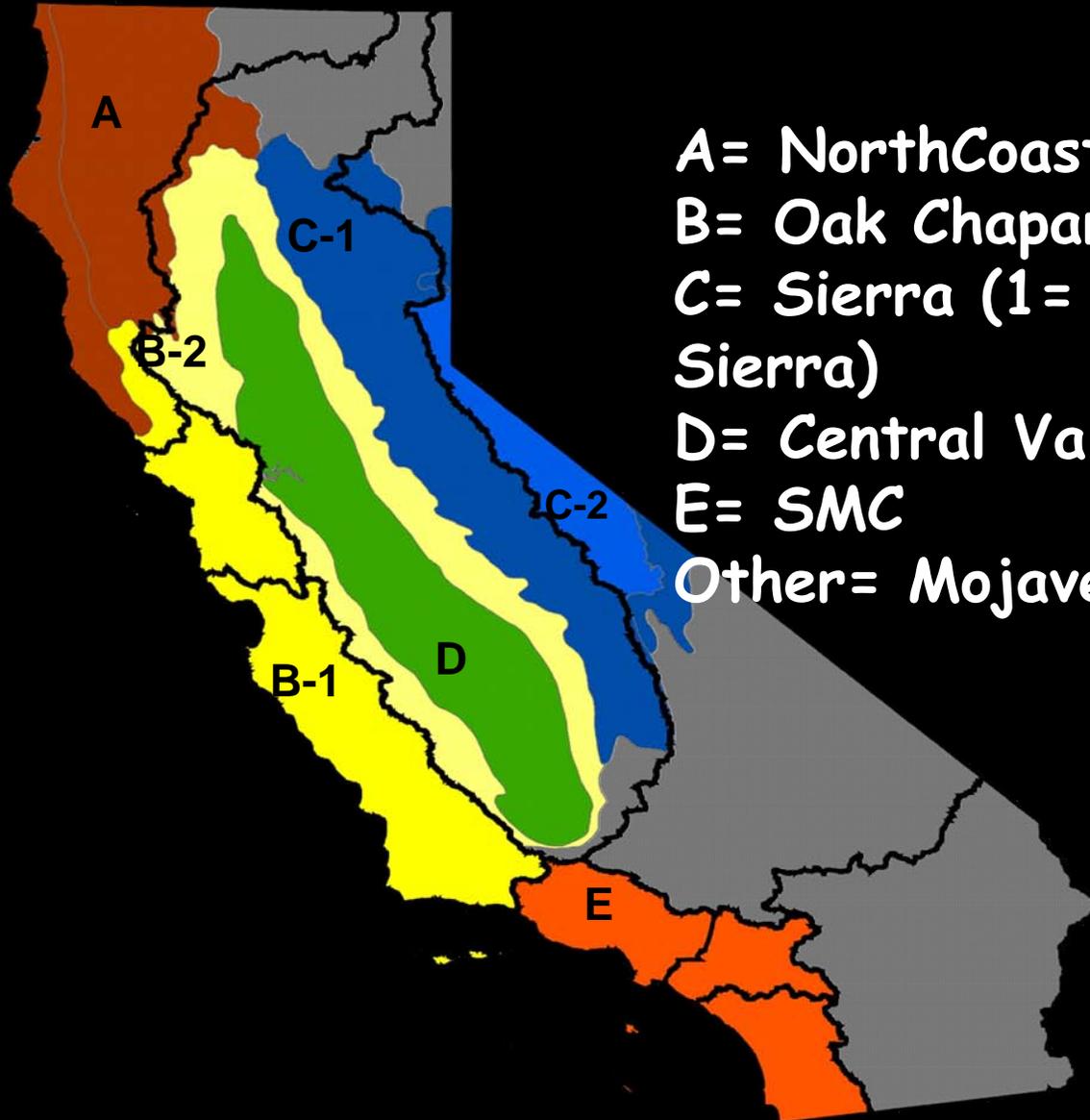
(increased risk of biotic impairment associated with various stressors)



# Rapid Biological Assessment 2007 SWAMP Procedures



# Perennial Stream Assessment (PSA)



A= NorthCoast

B= Oak Chaparral (1= coastal, 2=interior)

C= Sierra (1= West Sierra, 2= East Sierra)

D= Central Valley

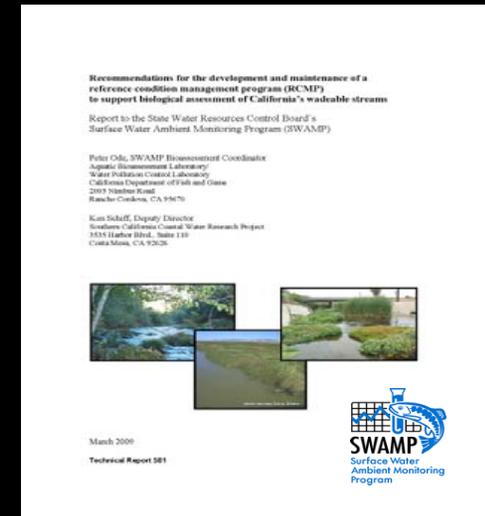
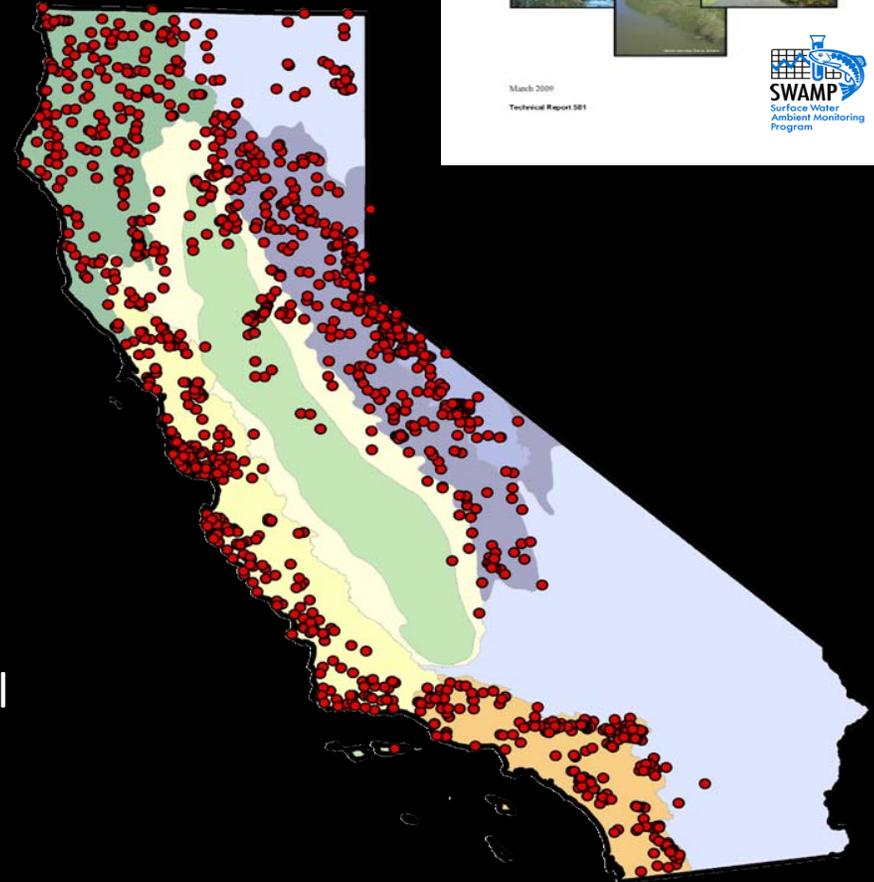
E= SMC

Other= Mojave/Sonora + Modoc Plateau

# Reference Condition Management Plan

*(adopted March 2009)*

- RCMP is SWAMP's standardized process for identifying & sampling "reference sites" throughout CA
- Now in implementation phase:
  - ✓ Screen existing sites (~1500) with GIS and local data
  - ✓ Identify data gaps and collect bio/chem/hab data where missing
  - ✓ Monitor temporal variability (both inter-annual & intra-annual)



# Why Does the EPA/SWRCB Want Bioassessments for California



- Clean Water Act Section 101(a)

Purpose:

- *"To restore and maintain the chemical, physical and biological integrity of the Nation's waters"*



# Advantages of Bioassessment

Integrates the effects of water quality over time

Sensitive to multiple aspects of water and habitat quality

Provides the public with a more familiar expressions of ecological health

# Advantages of Bioassessment

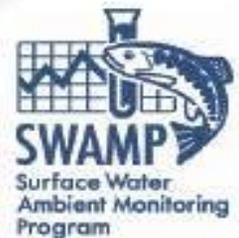
Adds a more direct assessment of ecological health since it measures the biological communities that live in aquatic systems

Better defines the effects of point source discharges and provides more relevant measures to evaluate discharges of non-chemical substances (e.g. sediment, flow augmentation and habitat alteration)

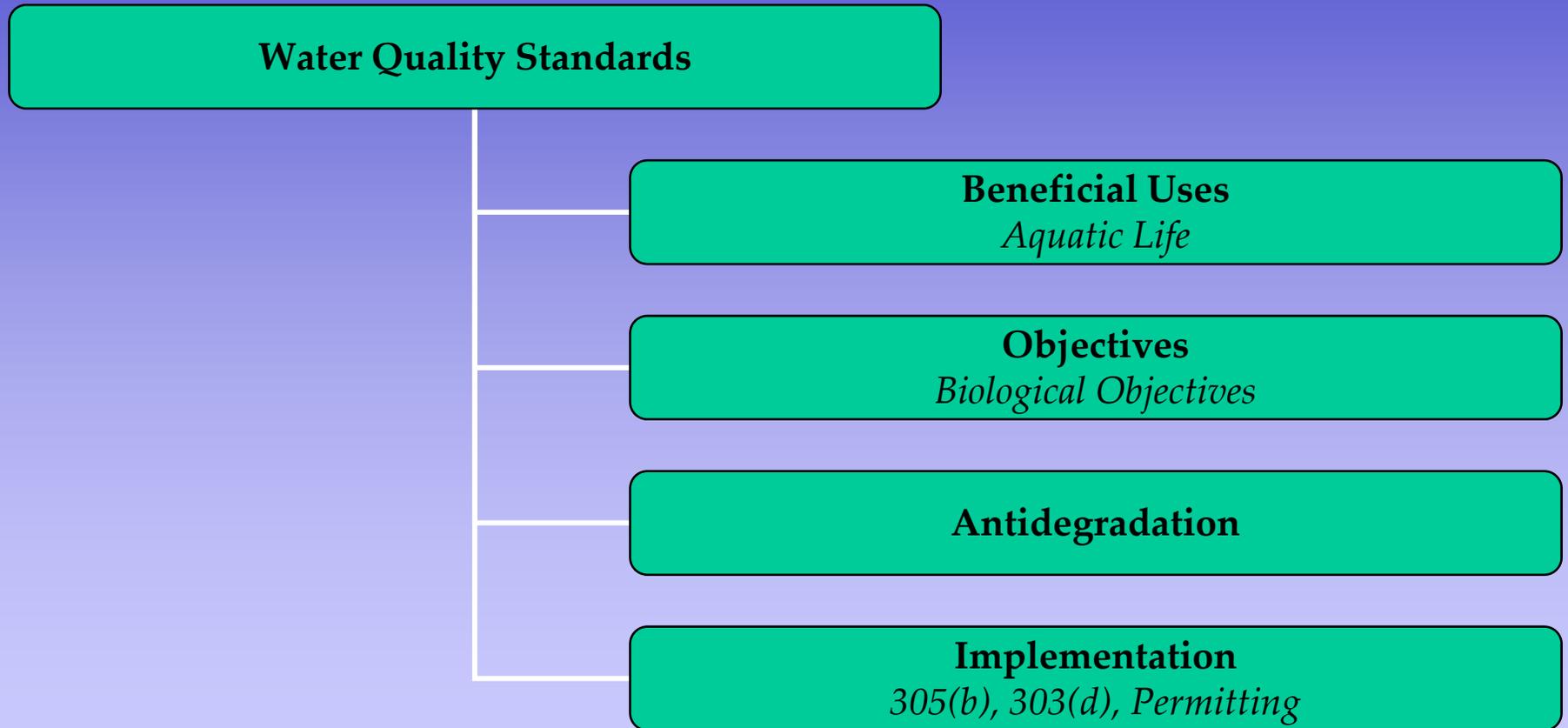
# Developing Biological Objectives for California Streams and Rivers

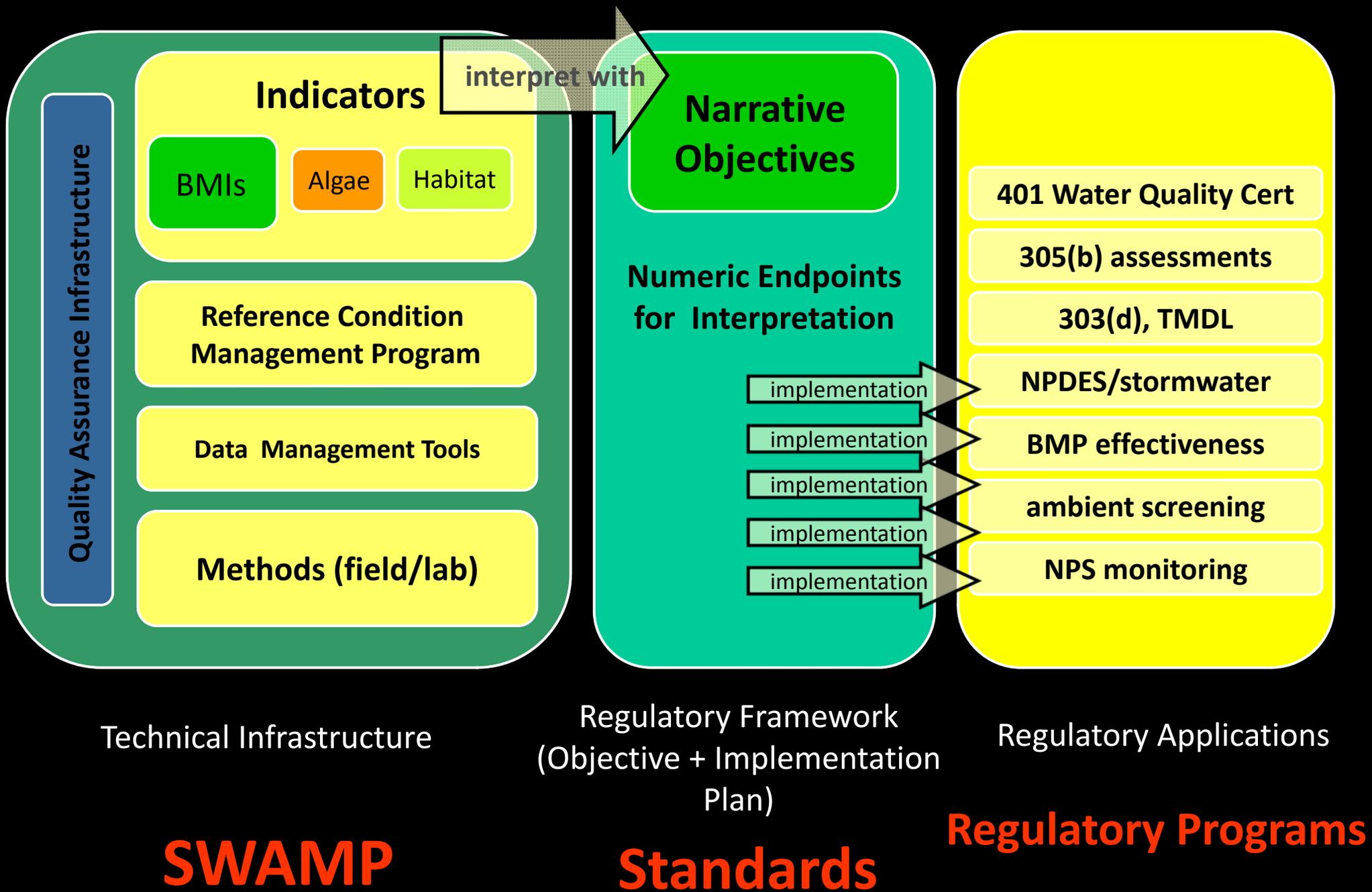


*Kick-off meeting  
March 8 and 11, 2010*



# What are biological objectives?





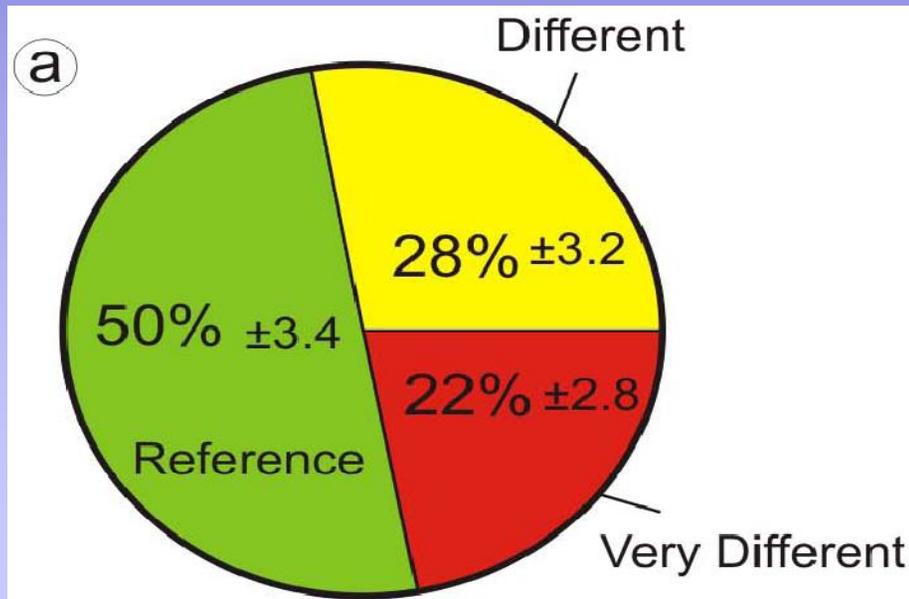
**SWAMP**

**Standards**

**Regulatory Programs**

# Healthy Stream Initiative (HSI)

HSI is the set of physical chemical and biological objectives along with the programmatic tools to protect the streams of California



- **Protect high quality streams**
- **Protect threatened streams from degradation**
- **Set restoration goals for impaired streams**

# Healthy Stream Initiative

## Objectives

### Chemical Objectives

### Toxicity Objectives

### Biological Objectives

- Perennial streams

### Habitat Objectives

- Hydromodification
- Riparian Policy
- Physical/habitat quality

## Programmatic Tools

- 305b and 303d Assessments
- NPS
- NPDES
- Stormwater
- 401 Certification; wetlands
- TMDLs
- Compliance/Enforcement
- Antidegradation
- Grant project effectiveness
- Water Rights impact assessment

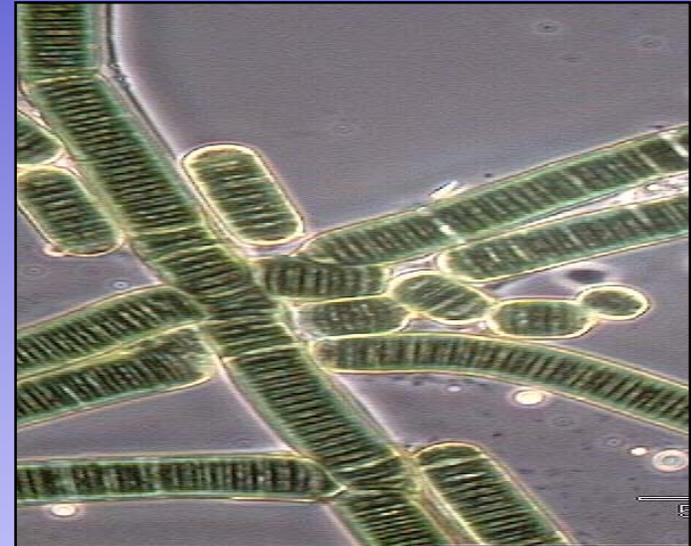
# How Do We Do Bioassessments In California



# FRESHWATER BIOASSESSMENT - THE USE OF AQUATIC ORGANISM TO MEASURE AQUATIC HEALTH -

EPA Recommendation:

Multiple Assemblages  
Fish, Invertebrates and Algae



# Benthic Macroinvertebrates

A detailed photograph of a stonefly nymph, a type of benthic macroinvertebrate, clinging to a green stem underwater. The nymph has a segmented body with brown and tan patterns, long antennae, and six legs. The background is a clear, greenish-blue water environment with other green stems and leaves visible.

Ubiquitous

Relatively stationary

Their large species diversity provides a spectrum of responses to environmental stresses

# Sensitive Organisms in Streams

## Dragonflies and Damselflies



## Mayflies



## Stoneflies



## Caddisflies



Expected Response to Stress: ↓ abundance & proportion

# Tolerant Organisms in Streams

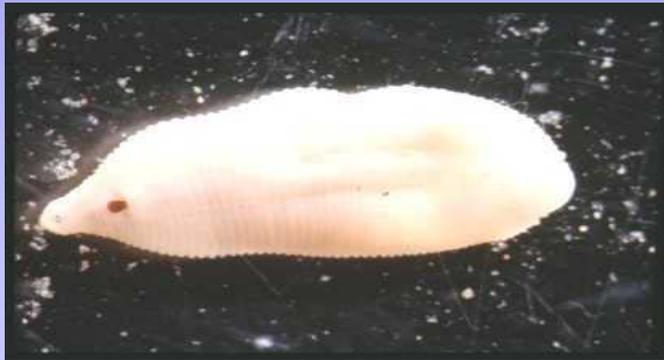
**Scuds**



**Snails**



**Leeches**



**Midges**



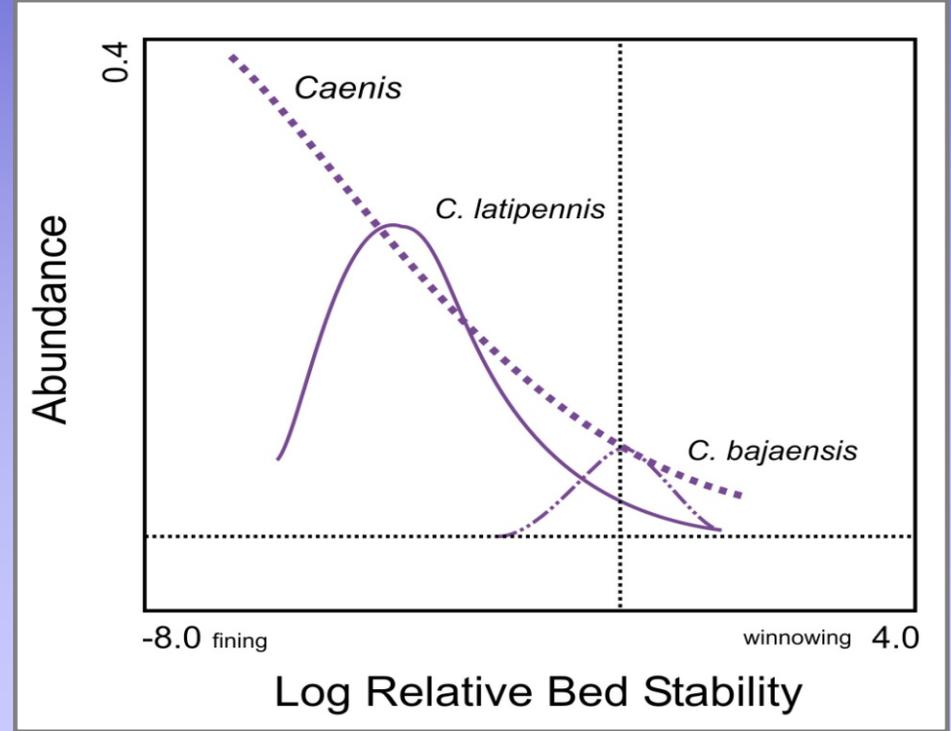
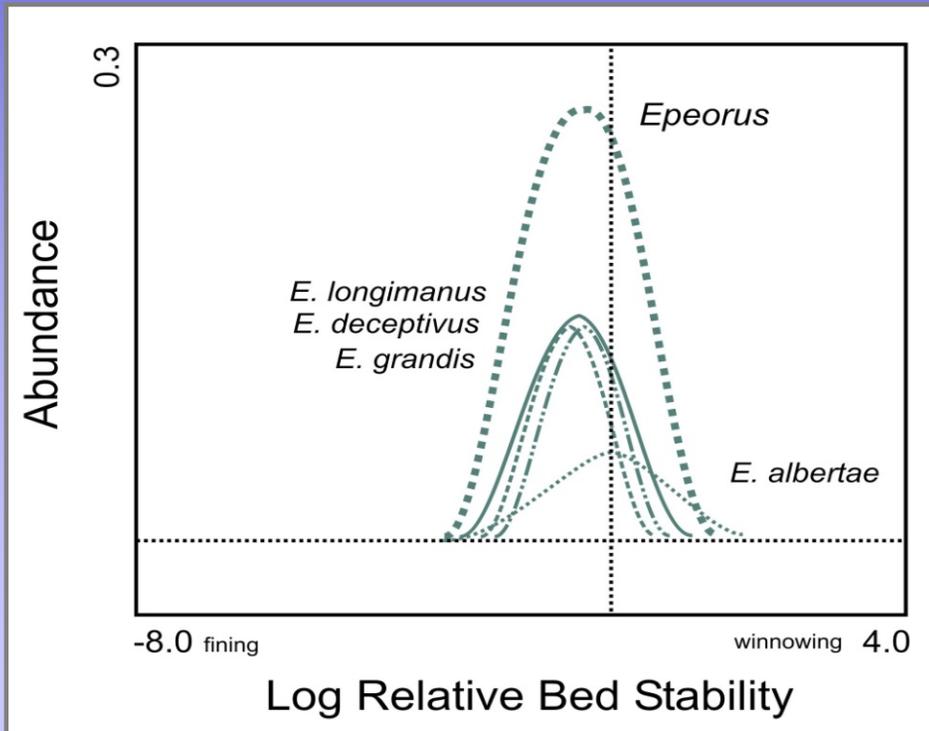
Expected Response to Stress:  abundance & proportion

# Sediment intolerant vs. sediment tolerant

*Epeorus*



*Caenis*



# BMI Metrics

**Stoneflies**

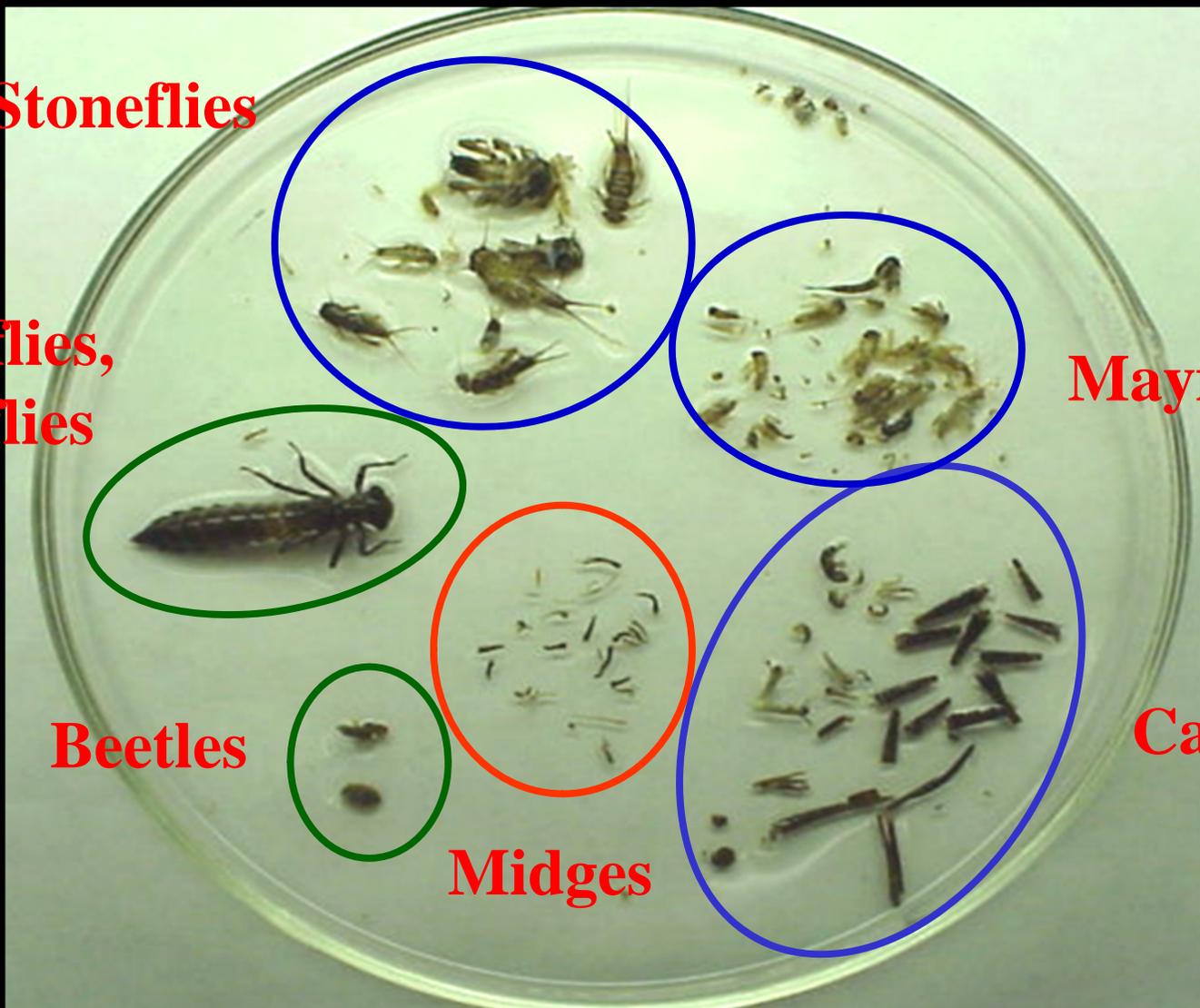
**Dragonflies,  
Damselflies**

**Mayflies**

**Beetles**

**Midges**

**Caddisflies**



# Types of BMI Metrics

## **Richness Measures**

EPT Taxa

## **Composition Measures**

Percent EPT Individuals

## **Tolerance/Intolerance Measures**

Percent Sensitive EPA Taxa

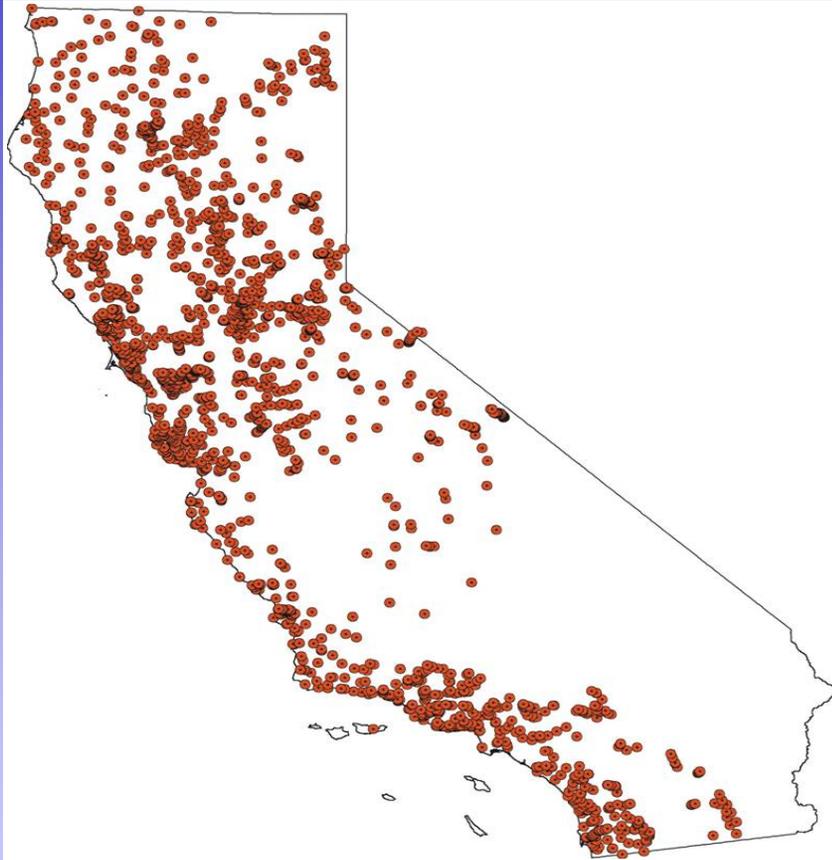
## **Functional Feeding Groups**

Percent Shredder Taxa

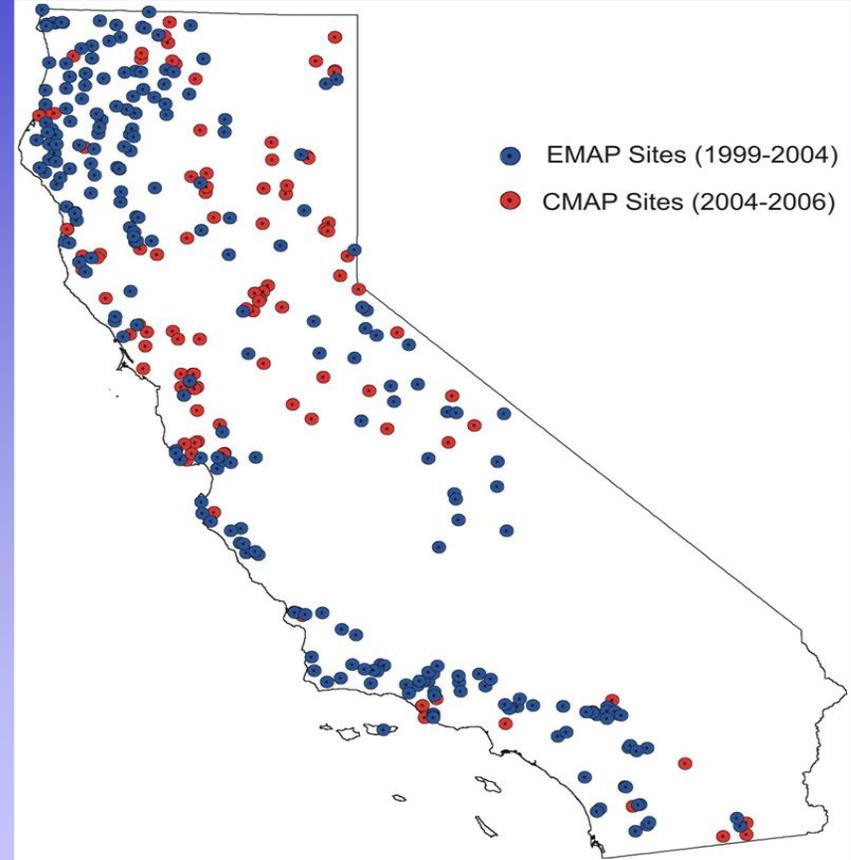
Total of 134

SAFIT Standard Taxonomic Effort I & II

All ABL processed sites  
(1993-2006)



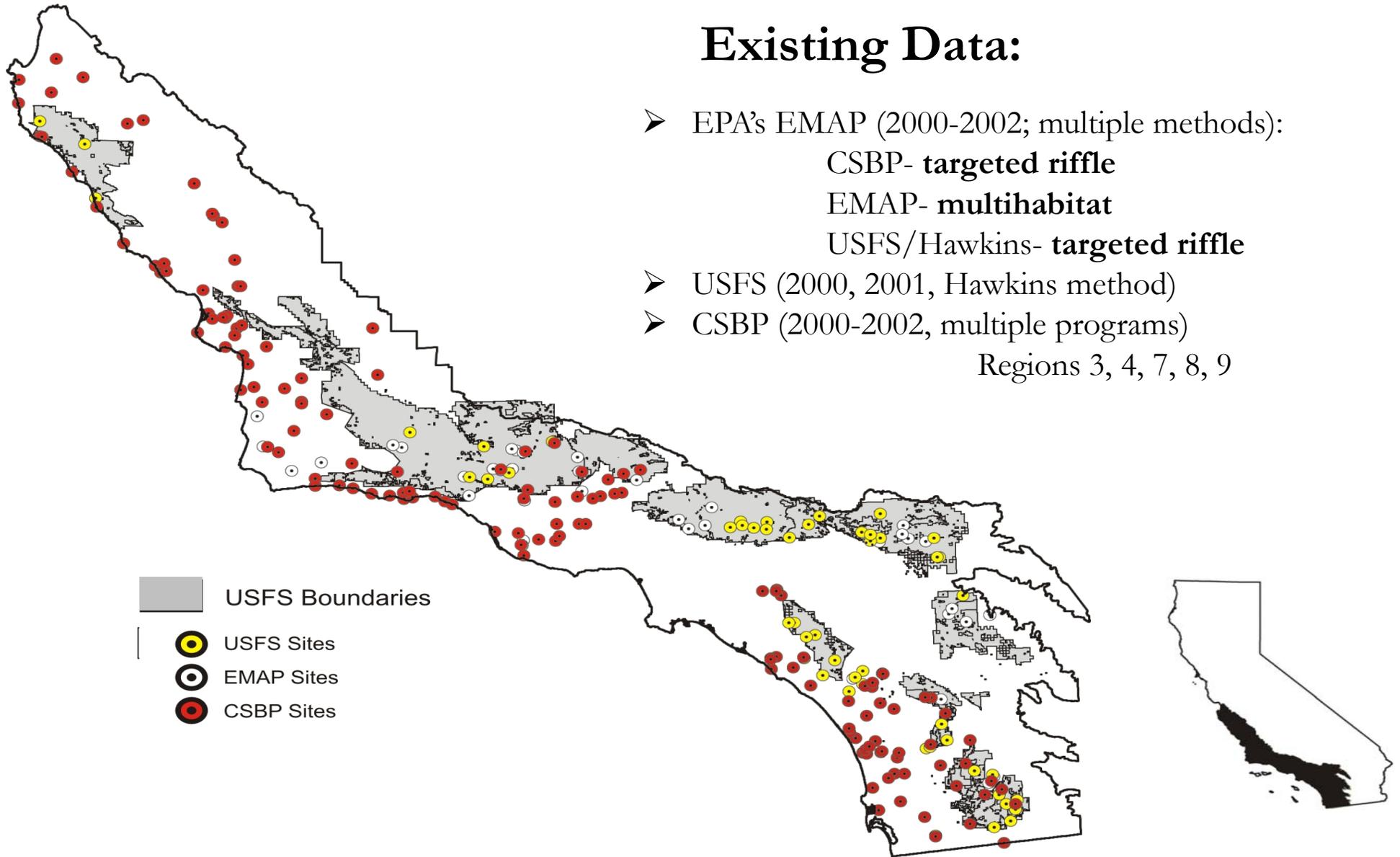
Probability survey sites  
(2000-2006)



**More than 17,000 sites as of 2010**

# Existing Data:

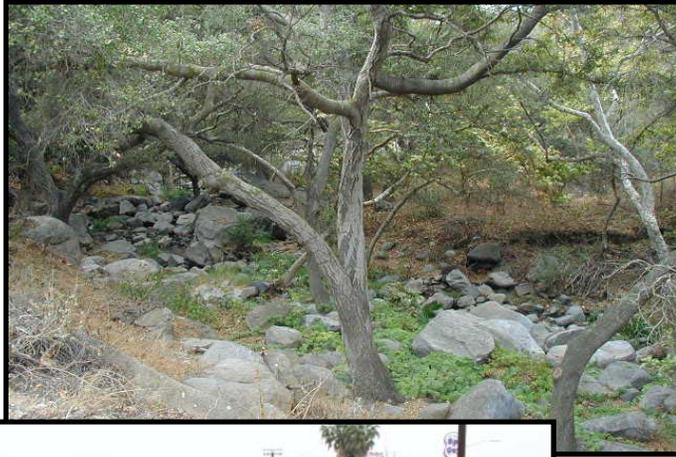
- EPA's EMAP (2000-2002; multiple methods):
  - CSBP- **targeted riffle**
  - EMAP- **multihabitat**
  - USFS/Hawkins- **targeted riffle**
- USFS (2000, 2001, Hawkins method)
- CSBP (2000-2002, multiple programs)  
Regions 3, 4, 7, 8, 9



# Application of a benthic invertebrate IBI to regional 305(b) reporting in southern California

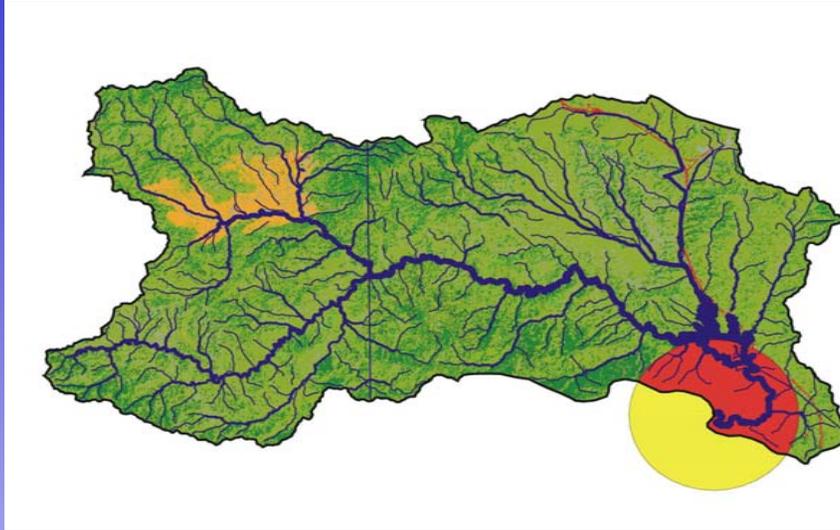
Peter R. Ode, Andrew C. Rehn and Jason T. May

*Aquatic Bioassessment Laboratory*  
*Water Pollution Control Laboratory*  
California Department of Fish and Game  
California State University, Chico

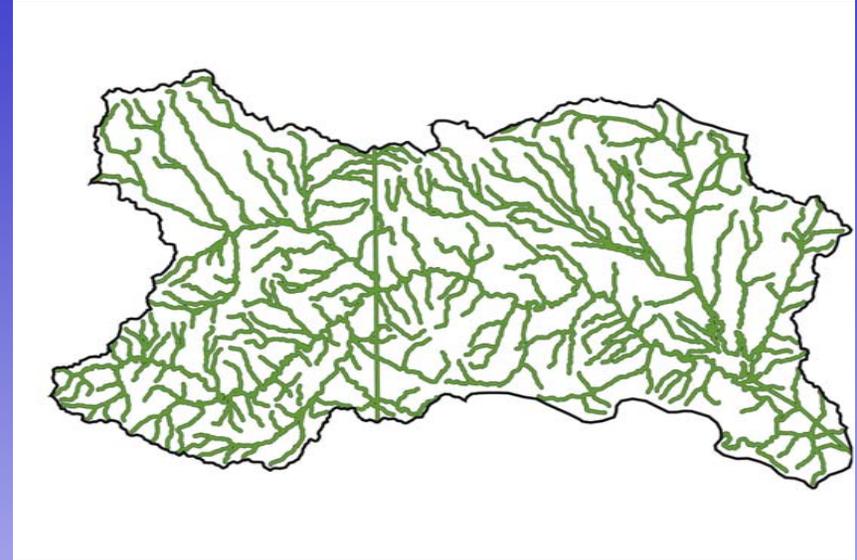


Ode, P.R., A.C. Rehn and J.T. May. 2005. A quantitative tool for assessing the integrity of southern coastal California streams. *Environmental Management*. 35:493-504

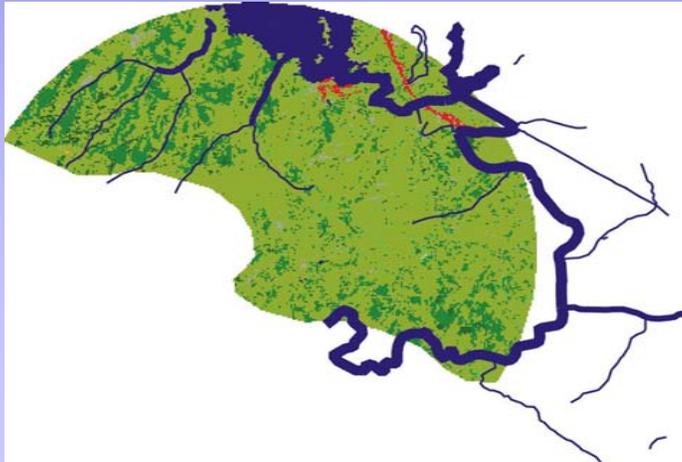
# GIS Landuse Analysis at 4 Spatial Scales



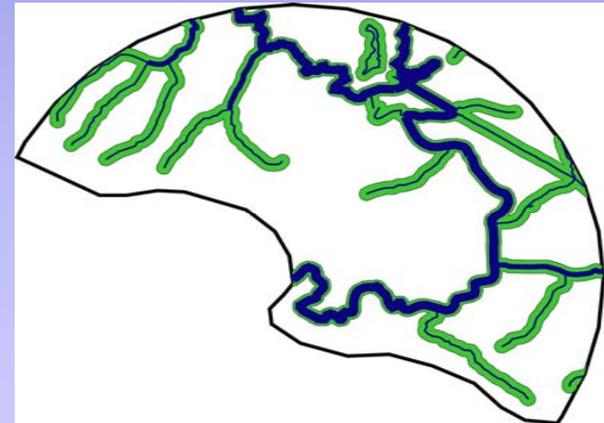
Watershed



Watershed Stream Buffer (120m)

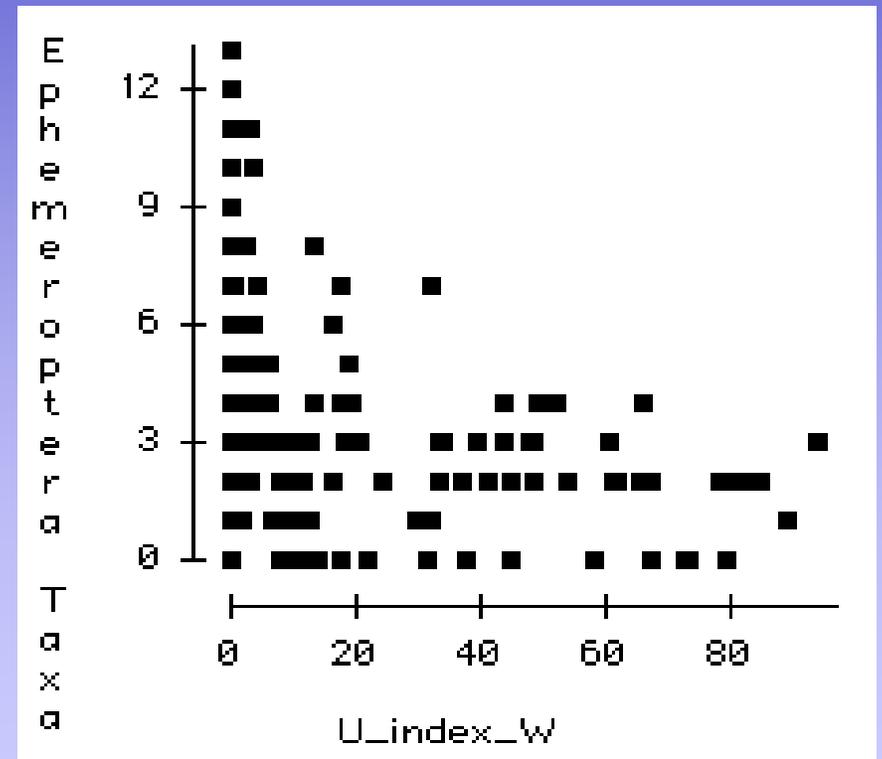
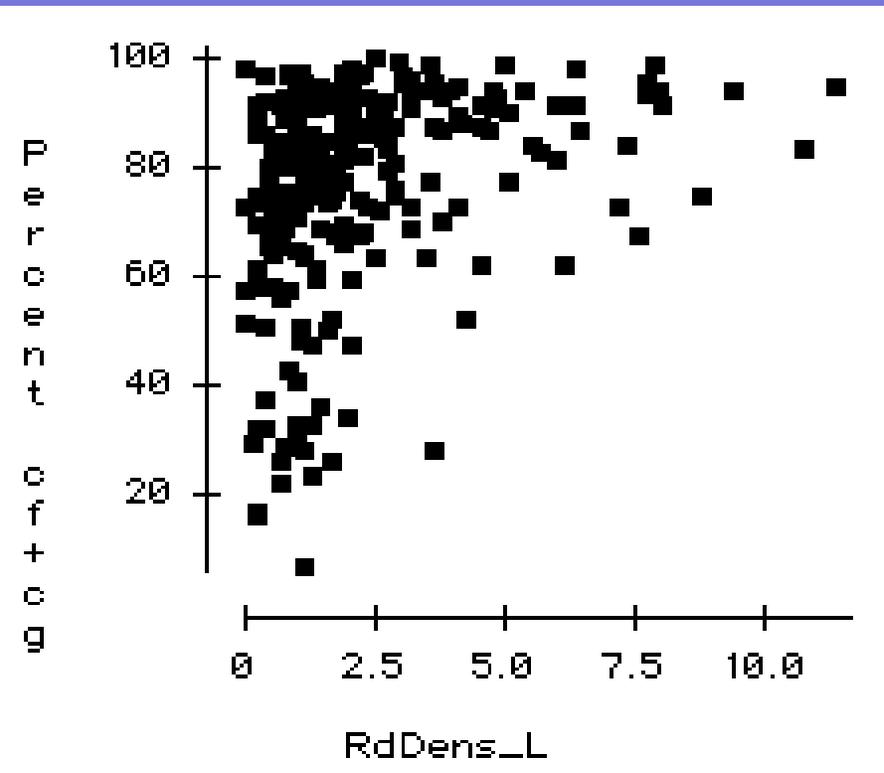


5 km Buffer



5 km Stream Buffer

# 100+ BMI Metrics Tested for Response to Human Disturbance Base on Land-use



Select responsive biotic metrics that are uncorrelated with each other:

1. Percent collector filterer  
+ collector gatherer individuals
2. Percent non-insect taxa
3. Percent tolerant taxa
4. Percent intolerant individuals
5. EPT richness
6. Coleoptera richness
7. Predator richness

# SoCal IBI Scores

Metric Score	N_Coleop_T	N_EPT_T		N_Pred_T	P_CFCG_I		P_Int_I		P_NonIns_T	P_Tol_T
	All Sites	6	8	All Sites	6	8	6	8	All Sites	All Sites
10	>5	>17	>18	>12	0-59	0-39	25-100	42-100	0-8	0-4
9		16-17	17-18	12	60-63	40-46	23-24	37-41	9-12	5-8
8	5	15	16	11	64-67	47-52	21-22	32-36	13-17	9-12
7	4	13-14	14-15	10	68-71	53-58	19-20	27-31	18-21	13-16
6		11-12	13	9	72-75	59-64	16-18	23-26	22-25	17-19
5	3	9-10	11-12	8	76-80	65-70	13-15	19-22	26-29	20-22
4	2	7-8	10	7	81-84	71-76	10-12	14-18	30-34	23-25
3		5-6	8-9	6	85-88	77-82	7-9	10-13	35-38	26-29
2	1	4	7	5	89-92	83-88	4-6	6-9	39-42	30-33
1		2-3	5-6	4	93-96	89-94	1-3	2-5	43-46	34-37
0	0	0-1	0-4	0-3	97-100	95-100	0	0-1	47-100	38-100

<b>Very Poor</b> 0-14	<b>Poor</b> 15-28	<b>Fair</b> 29-42	<b>Good</b> 43-56	<b>Very Good</b> 57-70
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## Biological metrics for IBI

Number of coleopteran taxa

Number of EPT taxa

Number of Predator taxa

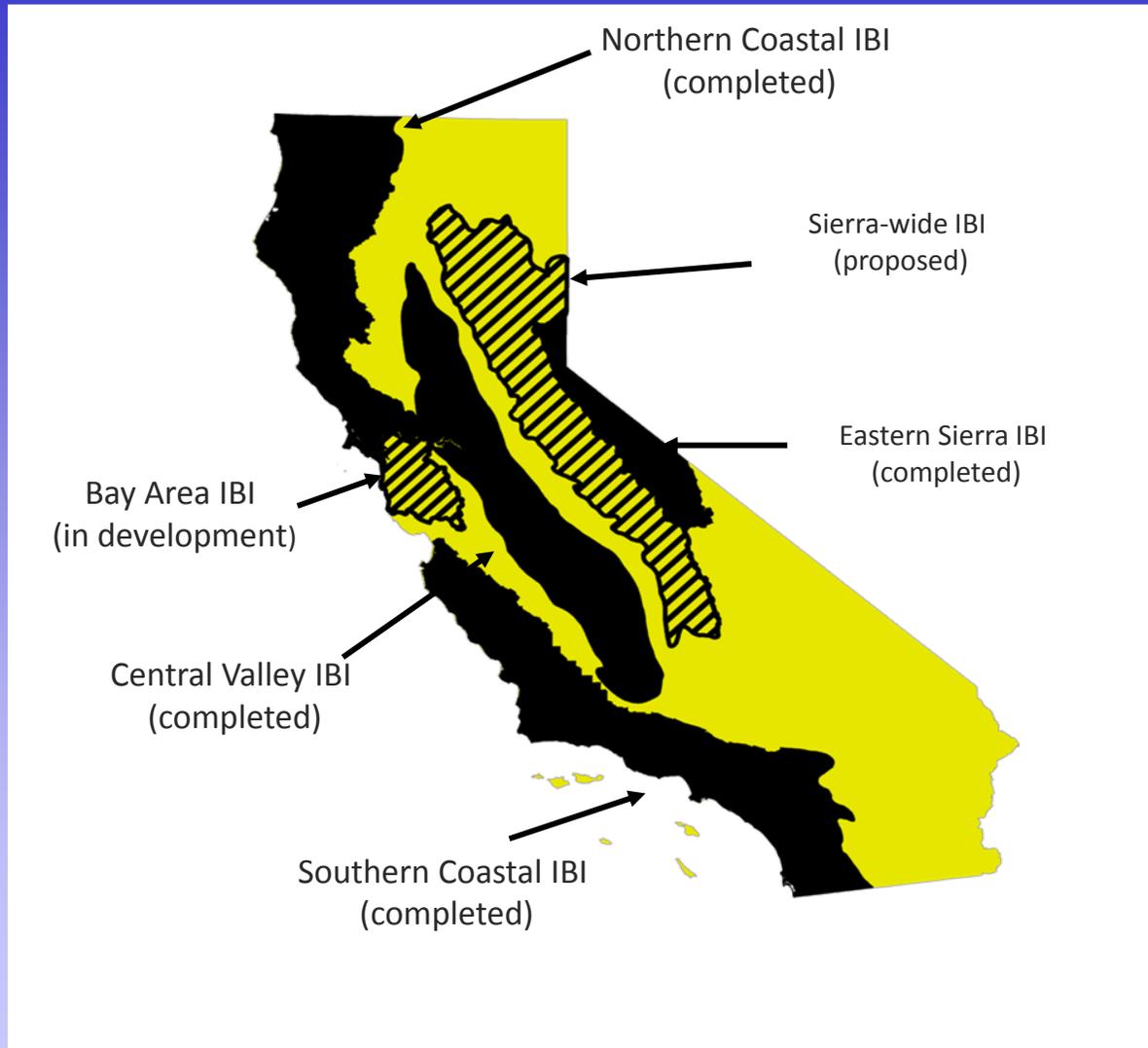
Percent collector filterers and collector gatherers

Percent Intolerant Individuals

Percent non-insect taxa

Percent tolerant taxa

# IBI Availability



# River Invertebrate Predictive and Classification System (RIVPACS)

Chuck Hawkins

Western Center for Monitoring and Assessment of  
Freshwater Ecosystems

Aquatic, Watershed, & Earth Resources

Ecology Center

Utah State University

O/E is a measure of the taxonomic completeness of the biological community observed at a site  
(value ranges from 0 to 1.0)



E = 8 taxa



O = 3 taxa

$$\frac{O}{E}$$
$$0.38$$



excellent to good biological condition (IBI = 100-60)

O/E > 0.8



**fair biological condition (IBI = 59-40)**

**O/E = 0.6**



**poor biological condition (IBI = 39-20)**

**O/E = 0.3**



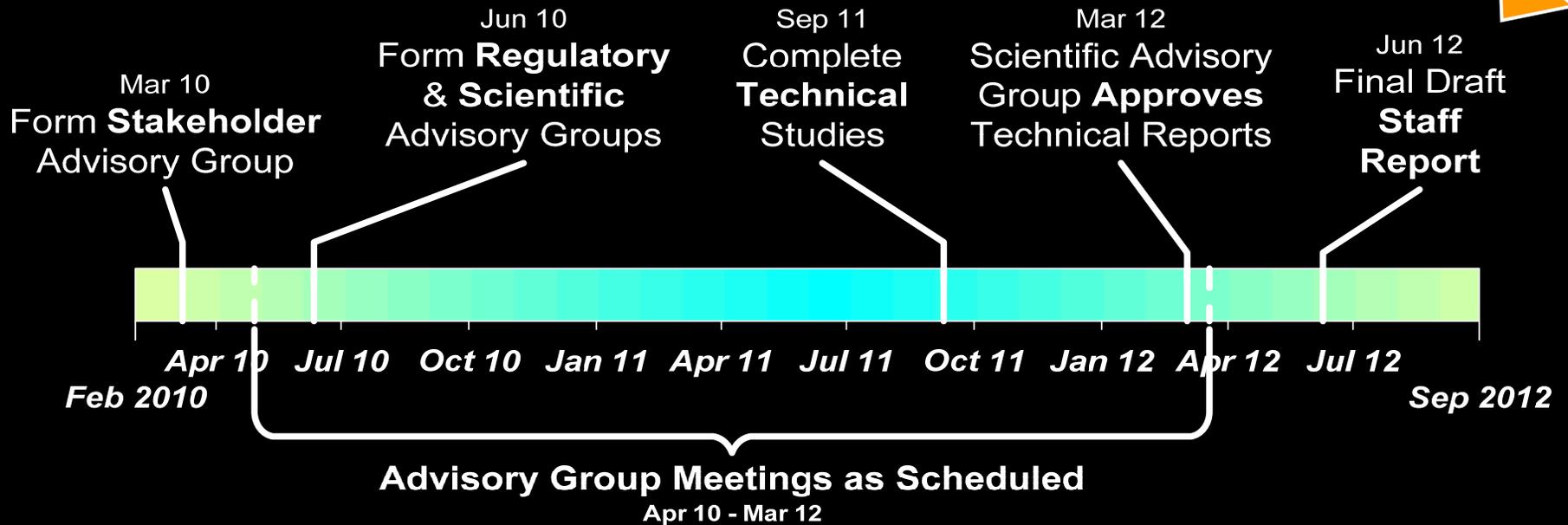
very poor biological condition (IBI < 20)

O/E < 0.2

# Achieving regulatory biological objectives in California

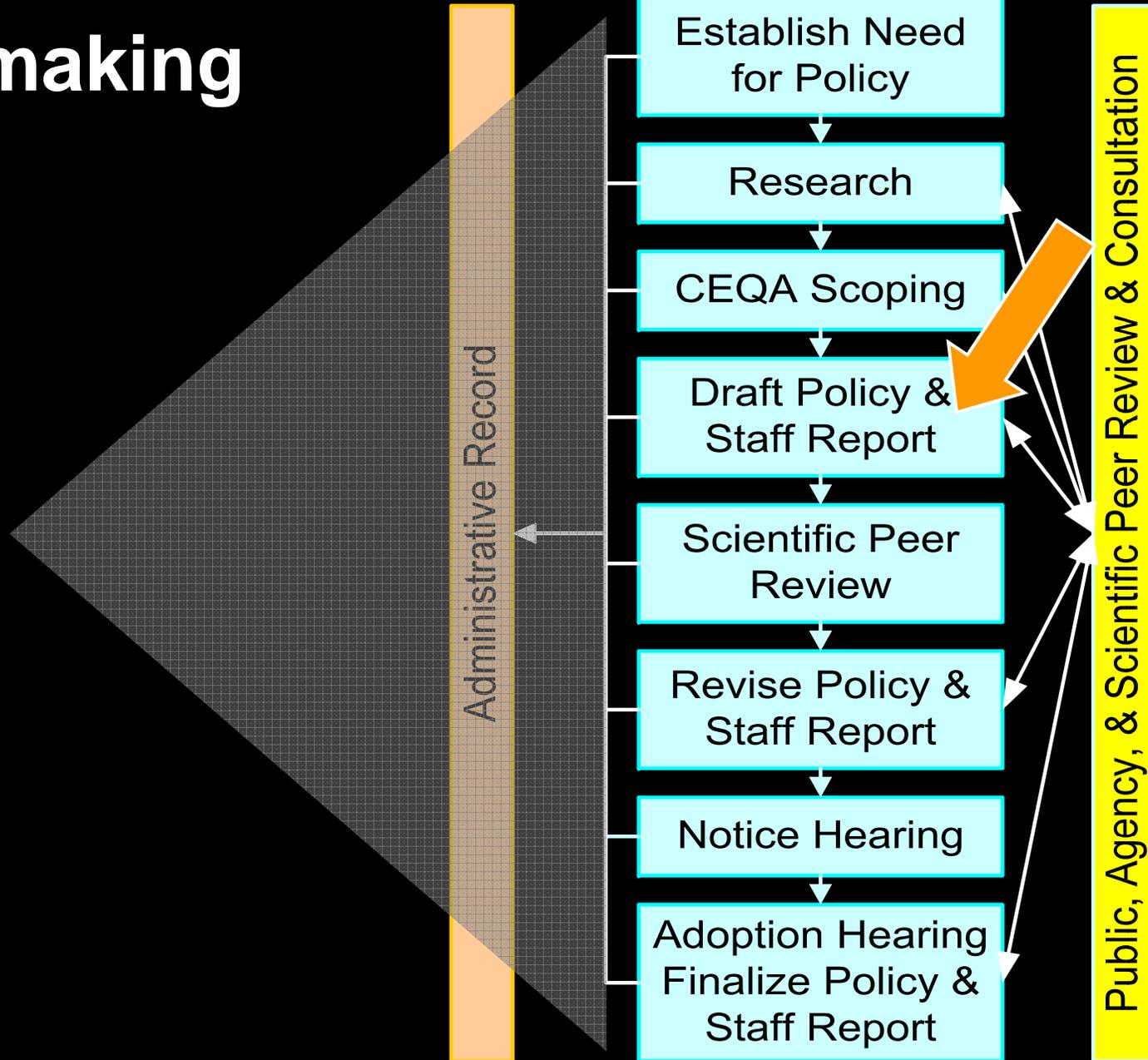


# Timeline of BioObjectives

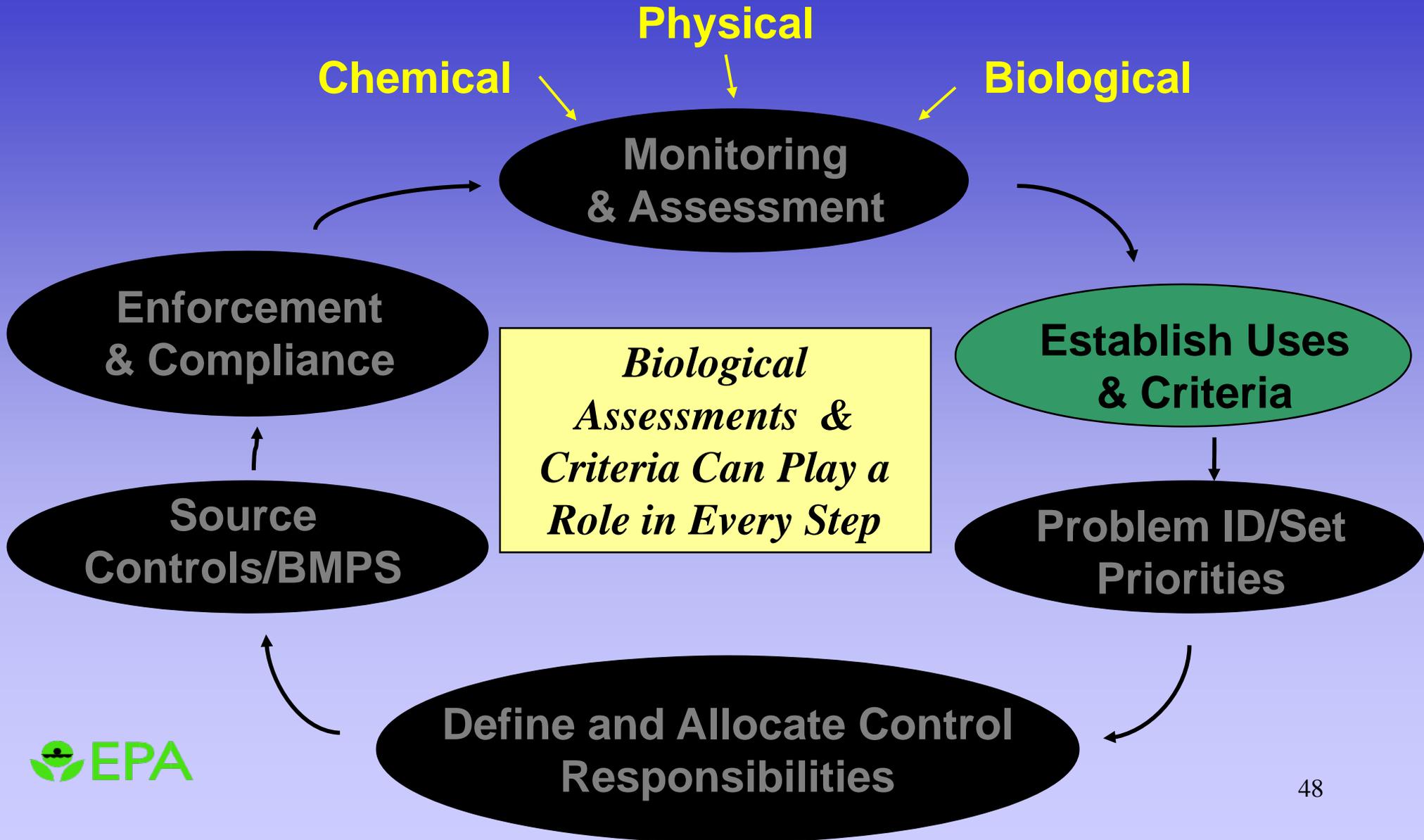


# Rulemaking

24 months  
Minimum

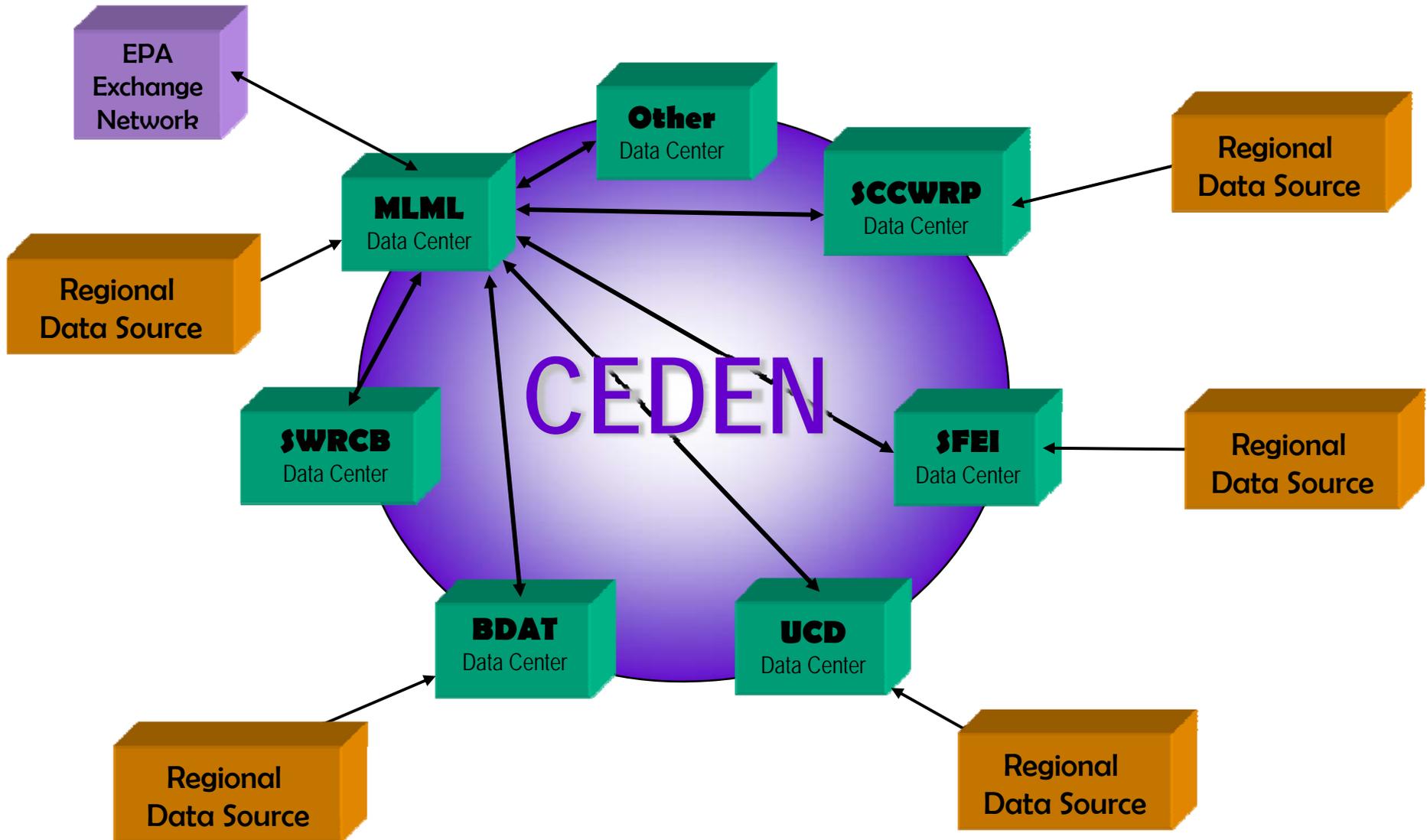


# CWA WATER PROGRAM



# CEDEN Network

## California Environmental Data Exchange Network



*Get to Know  
Your Mayflies*



# And your Beetles



Ringo

John

Paul

George